Galer, Rose

From: Rose, Jay
Sent: Tuesday, December 18, 2007 9:56 AM
To: Galer, Rose
Subject: FW: mox-tru in CLWRs...Finck 2007a
Attachments: LWR capabilities for MOX-IMF.doc

From: Phillip J Finck [mailto:Phillip.Finck@inl.gov]
Sent: Monday, October 15, 2007 10:22 PM
To: Michael Todosow; Rose, Jay; francis.schwartz@hq.doe.gov
Cc: Roald Wigeland
Subject: RE: mox-tru in CLWRs

thanks Mike; these are the numbers i needed

Phillip J. Finck, Associate Laboratory Director
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Michael Todosow <todosowm@bnl.gov>

10/15/2007 07:40 PM

To Phillip J Finck <Phillip.Finck@inl.gov>, Roald Wigeland <roald.wigeland@inl.gov>

cc

Subject RE: mox-tru in CLWRs

I've attached an earlier "guesstimate" (2004) of which current US reactors can probably use partial or full MOX cores.

The only currently operating reactors specifically designed for full-core MOX are the three CE-System 80 plants at Palo Verde, so mm=3. However, I don't know what the plants have actually been licensed for.

Assuming my assumptions are a reasonable basis for deciding which reactors are candidates, nn=34 (PWRs) and 14 (BWRs), but it's probably too strong to say that theses plants "have been designed to use 30% MOX"; probably a more appropriate way of wording it would be that they "can likely accommodate 30% MOX loadings without significant modifications".

At 08:14 PM 10/14/2007 -0600, Phillip J Finck wrote:

The MOX multirecycle argument goes as follows (Mike: do you have the numbers to put in there)

MOX fuel has slightly higher thermal absorption cross sections when compare to standard UO2 fuel; thus, when MOX assemblies are introduced in a LWR the neutron spectrum becomes harder and the efficiency of control mechanisms (control rods, soluble poison) is somewhat reduced; a simple design approach (e.g. increase the number of control rods) can be used to remedy this effect. The safety consequences of using MOX fuel are also well understood. Amongst the 103 operating US reactors, nn have been designed to use 30% MOX loadings, and mm can handle 100% MOX loadings. In all cases, nevertheless, these reactors need to be relicensed for MOX fuel.
MOX multirecycle has been studied at length, though it has never been practically implemented. In general, it is likely that reactors can be designed to handle multirecycled MOX, though care must be taken at the design stage to account for neutronic effects due to the shift of the Pu isotopic vector to the higher isotopes of Plutonium.
Studies for the multi-recycle of all TRU elements in LWRs have concluded that while reactors and fuel assemblies containing TRU can be designed within the standard safety margins, the practical design of the reactor fuel handling strategy and the design of associated fuel cycle strategies would be significantly more complex than for the MOX cycle.

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"Rose, Jay" <Jay.Rose@tetratech.com>

10/14/2007 09:40 AM

To

"Schwartz, Francis (NE-HQ)" <Francis.Schwartz@hq.doe.gov>, "Phillip J Finck" <Phillip.Finck@inl.gov>

cc

"Itani, Maher" <Maher.Itani@tetratech.com>, "Dave Nulton" <jnulton@durango.net>

Subject

RE: mox-tru in CLWRs

We will clarify that for the GNEP option.... because we have a multi-pass thermal recycle alternative, I think we will have more than enuff coverage to select an option such as that.....

-----Original Message-----
From: Schwartz, Francis (NE-HQ) [mailto:Francis.Schwartz@hq.doe.gov]
Sent: Sunday, October 14, 2007 11:37 AM
To: Rose, Jay; Phillip J Finck
Cc: Itani, Maher; Dave Nulton
Subject: RE: mox-tru in CLWRs

All - Just to confirm - For the GNEP alternative, the program still wants the capability to do more than a single pass in thermal reactors.

Frank

-----Original Message-----
From: Rose, Jay [mailto:Jay.Rose@tetratech.com]
Sent: Saturday, October 13, 2007 9:16 AM
To: Phillip J Finck; Schwartz, Francis (NE-HQ)
Cc: Itani, Maher; Dave Nulton
Subject: mox-tru in CLWRs

Hi Phillip-

For GNEP we are considering an option to do a first pass recycle in thermal reactors. For that option, we state, "Once fabricated, the MOX-TRU fuel would be transported to commercial LWRs for use."

Thomas Fanning stated the following: "transported to commercial LWRs for use".... This assumes that they are designed to handle and use the fuel, which with current designs is not the case. An acknowledgement of this is needed.

I was under the impression that most commercial reactors could use MOX fuel without any major modifications (at least that's what the Pu Disposition Program seems to say).... Would that change for MOX-TRU?.... While I know the commercial LWRs would need license amendments, do you know if they would need any other major changes to handle and use the MOX-TRU fuel?

Please advise. Thx- j

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DRAFT
06/08/2004

	MOX		Inert Matrix Fuel	
	Fraction of Core	**Fraction of Fleet**	**Fraction of Core**	**Fraction of Fleet**
Current PWR (69)	0.30	(1),(2)	0.20	(2),(4)
Current BWR (35)	0.30	(1),(2)	0.20	(2),(4)
Future PWR (3)	1.00	1.00	0.50	(5)
Future BWR (3)	1.00	1.00	0.50	(5)

PWRs: 32 began commercial operation pre-1980; 37-post
BWRs: 21 began commercial operation pre-1980; 14-post

For the **Fraction of Core** estimates, these numbers are applicable to implementation options where the MOX or IMF are full assemblies; options like CORAIL or CONFU can probably load larger fractions.

(1) Memo from Steve Sheetz listed 25 "late-generation" Westinghouse PWRs that are potentially available. However, five of these reactors are "committed" to the MD MOX or tritium missions in the near term. Also, have the 3-CE System-80 plants which are capable of handling full-core MOX cores. Both the W 1000+ MWe class of plants and the CE System-80 design have been considered in AFCI studies by ANL and BNL. It is probably reasonable to guesstimate that the "newer plants" are the best/most likely candidates; based on post-1980 vintage plants the fractions would be:

PWR=(37/69)=0.54
BWR=(14/35)=0.40

(2) The following must also be taken into consideration:
- The age of the plant, and useful remaining lifetime, including life-extension/license renewal (primary basis for above guesstimate)
- Potential plant-specific issues related to pressure vessel fluence which could be exacerbated by the harder neutron spectrum with MOX
- Power uprates (planned or actual) may be in conflict with increased uncertainties that may be required for "novel" fuels

(3) While there are 50%-full-core MOX designs for EPR and AP-1000, these are not the designs that are being marketed/licensed. It's not clear whether one could just drop in a MOX core, or there would be other hardware changes to the reactor systems required

(4) Would guesstimate that "practical attractiveness" of IMF in U.S. is at best ½ that of MOX.

(5) Will depend on what the role of IMF would be in various nuclear futures. Requires some thought/discussion.

The impact of differences between Pu vs. Np+Pu vs. Np+Pu+Am vs. Np+Pu+Am+Cm on these estimates are probably second order. Would suggest that we assume that the Cm will be separated and stored separately for all the reasons identified in previous studies.